9 Ferrous and Nonferrous—General

ϕ USE OF TERMS YIELD STRENGTH AND YIELD POINT—SAE J450 JUN84

SAE Recommended Practice

Report developed by the Publication Policy Committee, approved by the Nonferrous Metals Committee and the Iron and Steel Technical Committee, June 1960, first revision by the Iron and Steel Technical Committee, Divisions 1 and 32, June 1984.

1. Definitions and Application—Yield strength is the stress at which a material exhibits a specified limiting deviation from the proportionality of stress to strain. The deviation is expressed in terms of strain which may be measured either by the Percent Offset method or by the Extension Under Load method as described in ASTM E8. The method of measurement must be stated when reporting yield strength. The term is applicable to materials whose stress-strain diagram in the area of transition from elastic to plastic strain is a smooth curve as well as to those which exhibit an upper yield point or sharp knee.

Yield point is a special case of yield strength which is defined as the first stress in the material, less than the maximum attainable stress, at which an increase in strain occurs without an increase in stress. Since in their commercial form only ferrous metals exhibit this phenomenon and then only under some circumstances, it follows that the term yield point has only limited application to the results of tensile testing of ferrous metals and is not applicable to the testing of nonferrous metals.

2. Recommended Usage

Nonferrous Metals—Only the term yield strength is applicable. Specifications and test reports must always state the method of test and limiting values of strain.

Ferrous Metals—Yield strength is the general term and it is applicable to stress-strain curves of both the smooth, rounded type, and the sharp kneed type. When reporting yield strength, the method of test and limiting values of strain must be stated.

Strictly interpreted, the term "yield point" is intended for application only in those cases in which the material exhibits the unique characteristics defined previously under yield point. However, there are some specifications which prescribe a yield point for materials which have smooth stress-strain curves. In such cases, a value equivalent to the yield point in practical significance may be determined by the use of dividers or by the Extension Under Load method.

For a more detailed discussion of the terms involved and a description of the applicable methods of test, refer to the following:

ASTM E6, Definitions Relating to Methods of Testing.
ASTM E8, Tension Testing of Metallic Materials.
ASTM A370, Mechanical Testing of Steel Products.

SURFACE TEXTURE MEASUREMENT OF COLD ROLLED SHEET STEEL—SAE J911 JUN86

SAE Recommended Practice

Report of the Iron and Steel Technical Committee, approved January 1965, and reaffirmed June 1986.

1. Scope

1.1 This SAE Recommended Practice describes a method for measuring the surface texture of cold rolled, matte finish sheet steel with a roughness average (R_a) of 20–80 μ in.

1.2 The method includes a system for equipment calibration and procedures for determining the arithmetical average surface roughness (R_a) and the average peak density (peaks per inch (ppi)) on sheet metal surfaces.

2. Equipment and Materials

2.1 Digital Surface Roughness and Peak Counting Instrument—Bendix QHD or equivalent.

2.2 Instrument and precision reference specimens shall comply with specifications for stylus type instruments as detailed in the American National Standards Institute ANSI B46.1-1978 or SAE J449.

2.3 The instrument shall be calibrated in terms of arithmetic average (R_a) and peaks per inch (ppi) on a precision reference specimen consisting of:

1. Calibration check—a 120 μ in typical roughness patch,
2. Linearity check—a 20 μ in typical roughness patch, and
3. A stylus check patch as shown in Fig. 1.

The contour material, accuracy, and uniformity of the precision reference specimen shall comply to requirements described in ANSI B46.1-1978.

2.3.1 The 120 μ in patch is used to provide the basis for surface roughness (R_a) and peaks per inch (ppi) calibration.

2.3.2 The 20 μ in patch is used to insure linearity of the instrumentation and moderate frequency system response.

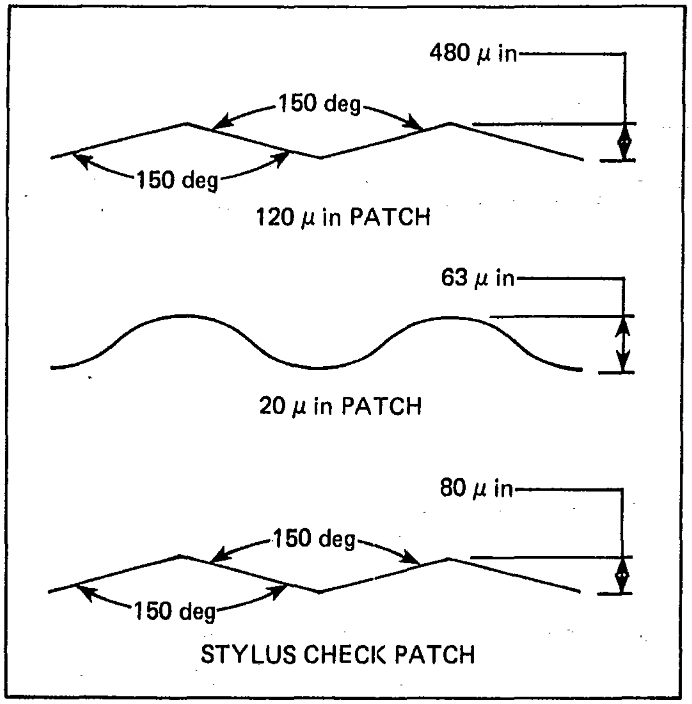
2.3.3 Finally, the stylus check patch provides necessary calibration information regarding stylus condition, effective size, and high frequency system response.

2.4 Sample material selected for measurement shall be representative of the material as produced. The area tested should be at least 2 in from the coil edge. Samples for sheet examination shall be identified as to rolling direction, suitably flat, and the sample size large enough to run the tests. (A convenient size is 6 in long and 4 in wide, with the longer dimension parallel to the direction of rolling.)

3. Definitions

3.1 Roughness Average—The surface roughness average (R_a) shall be reported in microinches as the arithmetical average of the absolute deviations from the median line established within the limits of the roughness width cut-off.

Surface roughness consists of the finer irregularities in the surface tex-



PRECISION REFERENCE SPECIMEN
SPECIFIC FOR CALIBRATION

Reference Specimen	Roughness, μ in	Peak Count, ppi
120 μ in	117 ± 1.0	267–269 at 50 μ in level[a]
20 μ in	18–21	710–730 at 10 μ in level
Stylus check	12–20	1655–1695 at 10 μ in level

[a]For those instruments which have two 50 μ in count levels, peak count readings on both settings shall be within 2%.

FIG. 1—CALIBRATION MEASUREMENTS

ture usually including those irregularities which result from the inherent action of the production process. These are considered to include transverse feed marks and other irregularities wherein the limits of the roughness width cut-off.

3.2 Peak—A surface irregularity wherein the profile intersects consecutively a lower and an upper boundary line. The boundary lines are located parallel to and equidistant from the profile mean line as established within the limits of the roughness width cut-off. The vertical distance between these boundary lines is termed the peak count level.

3.2.1 Peak Count Level—The vertical distance (in microinches) between the boundary lines described in the definition of "peak," see Fig. 2.

3.2.2 Peak Density—The peak density is the number of peaks per inch measured at a specific peak count level. The value of peak density is reported in units of peaks per inch (ppi).

4. Test Procedure

4.1 Preparation—The following items should be inspected to insure proper operation of the measuring equipment.

(a) Secure all cable connections.
(b) Tighen mechanical fastening of posts, link arms, etc.
(c) Adjust link arm to be free to rotate about its axis.
(d) Both link arm and sample must be level and parallel.
(e) Adjust stroke to 1-1/8 in.
(f) Set roughness mode to arithmetic average R_a (formerly AA).
(g) Set pilot or speed selector to correspond to the pilotor being used.
(h) Set width cut-off to 0.030 in.
(i) Set peak count level when measuring peak density.
(j) Check suitability of location. The suitability of the location can be checked by observing the roughness reading obtained on a smooth piece of glass. A reading of 2 μ in or less in the display indicates the location is suitably vibration free.
(k) Wipe test sample with a soft lint-free cloth.

4.2 Calibration—To achieve the greatest uniformity between instruments on sheet surface texture measurements, the following calibration procedure should be used as required based on individual instrument used and equipment manufacturer's recommendations.

4.2.1 Calibration Measurements—After preparation as described in paragraph 4.1, calibration measurements on the precision reference specimen shall be made to establish satisfactory operation of the instrument.

The calibration readings for both roughness and peak count should be obtained from the average of ten readings which are required to obtain correlation between various instruments and users. The instrument is set up to obtain readings that are in the direction indicated on the precision reference specimen (usually a double arrow). Five measurements are taken parallel and approximately $\frac{1}{16}$ in apart. After the trace is moved from one location to another, the first two or three readings should be discarded as the instrument needs this time interval to settle down. The precision reference specimen is then rotated 180 deg and five additional measurements are made again parallel and approximately $\frac{1}{16}$ in apart. Rotation of the reference specimen is done to compensate for any small error in leveling of the link arm workpiece. Finally an average of all ten readings is calculated. The calculated average is the calibration measurement.

If both the average roughness and peak count calibration measurements on the 120 μ in patch are within the ranges shown in Fig. 1, calibration measurements on the 20 μ in and stylus check patches may be taken. If calibration measurements are again within the ranges specified, sample surface texture measurements as described in paragraph 4.3 may be taken. However in the event that calibration measurements on the 120 μ in patch are initially not within the ranges specified in Fig. 1, instrument adjustment as described in paragraph 4.2.2 for average roughness adjustment or paragraph 4.2.3 for peak count adjustment should be attempted. After appropriate adjustments are completed to achieve satisfactory calibration measurements on the 120 μ in patch, linearity check measurements on the 20 μ in and stylus check patches should be made. As calibration adjustments are limited to those described in paragraphs 4.2.2 and 4.2.3, the inability of an instrument to provide a calculated surface roughness average or a calculated peak count average within the ranges shown in Fig. 1 for either the 120 μ in, 20 μ in, or stylus check patch after adjustment shall constitute the equipment to be defective.

Regardless of the cause of the improper reading, whether electrical or mechanical, e.g., dirt in the tracer, worn stylus, electrical instability, etc., sheet metal sample surface measurements taken with this equipment shall not be considered valid.

4.2.2 Roughness Adjustment—Ten readings are taken on the 120 μ in patch as described previously. Record the tenth reading, turn pilotor off, leave tracer head exactly where the tenth reading was taken—do not disturb this setup. Calculate the average for the ten readings. If the calculated average is not 117 ± 1.0 μ in, the pilotor is started tracing the same line as the tenth reading. A surface roughness adjustment is then made to change the tenth reading position by an amount equal to the

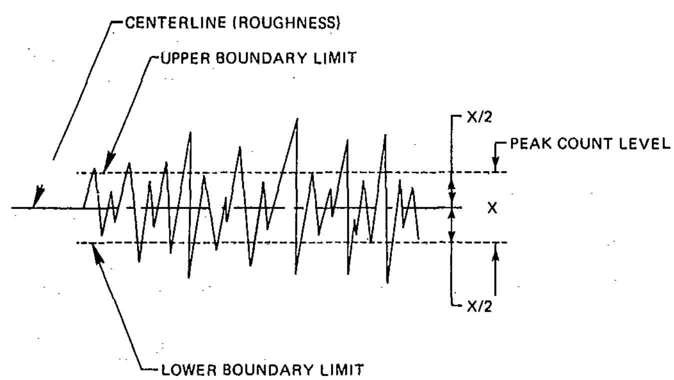


FIG. 2—PEAK COUNT LEVEL